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ABSTRACT

The concurrent validity of the Achievement Anxiety Test (AAT) and its factor structure are investigated to provide empirical evidence about the quality of AAT. State and trait anxiety were measured by State and Trait Anxiety Inventory (STAI), mathematics anxiety was assessed by a 24-item revised version of the 98-item Mathematics Anxiety Rating Scale (MARS-revised), and mathematics achievement was measured by a 48-item mathematics test derived from ACT's College Mathematics Placement Program (MT). The 19-item AAT consisted of two hypothetically independent subscales: facilitating (AAT+) and debilitating (AAT-). Mean and standard deviations for all tests were calculated, and a correlation matrix was completed which showed the instruments' interrelationships. A principal component factor analysis specifying a two factor solution was elected to provide a check on the soundness of considering AAT as being comprised of two independent factors. Results of the two factor varimax rotation showed that 16 of the 17 items had sufficiently high loadings on either of the factors, using .40 as the cutoff value.
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A Validity Investigation of the
Achievement Anxiety Test

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Abstract

Since 1960 educational researchers have been using the Achievement Anxiety Test (AAT), which presumably measures independent aspects of achievement anxiety, facilitating and debilitating. The developers report construct and predictive validity of the subscales using anxiety measures and performance criterions. However, the independence of the subscales and underlying factor structure of the test have been overlooked. Because the two subscales have been used as a difference score, the status of the interrelationship between the subscales is of concern. This study investigates the concurrent validity of the AAT and its factor structure to provide empirical evidence about the quality of AAT.

A Validity Investigation of the Achievement Anxiety Test

Achievement Anxiety Test (AAT) (Alpert & Haber, 1960) was developed to measure "not only the presence or absence of anxiety, but also whether the anxiety facilitates or debilitates test performance." Since its presentation, the AAT has received wide acceptance and usage. The journals reporting articles using the AAT span psychology, counseling and measurement. In the years 1969-1970, 34 journal citations in Psychological Citations Index were found for the AAT. More recently, 1978-1979, 29 citations were made.

The original version of the AAT consisted of 28-items, 10 of which comprised the Debilitation Scale, a 9-item Facilitating Scale, and 9-item neutral items. Since the neutral items are ignored in the scoring of the Facilitating and Debilitating subscales, a functional version of the AAT, which consists of the 19 items that make up the Facilitating and Debilitating subscale has been adopted by many practitioners. The analysis in this study will concentrate on the functional items of the AAT: 10 Debilitating and 9 Facilitating items.

The nineteen item AAT consists of two hypothetically independent subscales: Facilitating (AAT+), and Debilitating (AAT-). Test-retest reliability was reported as .87 and .83 for AAT+ and AAT-,

respectively. In validating the AAT+ and AAT- subscales, Alpert and Haber report high positive correlations between anxiety subscales of several anxiety scales (including Taylor Manifest Anxiety Scale, and Mandler-Sarason Text Anxiety Scale) with the AAT-Debilitating component. Negative correlations were reported for AAT+ with AAT- and with the other anxiety scales. Through a multiple regression procedure of AAT+ and AAT- on final examination, Alpert & Haber (1960) found that AAT+ provided a significant additional contribution of the prediction of achievement, thereby establishing AAT- as a necessary and separate component in the prediction of achievement.

Recently, Tryon (1980) reported a correlation of .64 for the Debilitating Scale with the Test Anxiety Questionnaire and at -.40 correlation for the Facilitating Scale and the Test Anxiety Questionnaire. The Debilitating and Facilitating Scales also correlate significantly ($r = -.37$).

Tobias and Abramson (1971) considered AAT+ and AAT- as variables in studying Aptitude X Treatment Interaction. They reported a significant interaction among facilitating anxiety and other performance variables, leading them to view AAT+ as achievement motivation rather than facilitating anxiety.

One possible use of the subscales AAT+ and AAT- is in combination, either using a median split of both or a quartile method (Towle and Merrill, 1975; Plake, Thompson, and Lowry, in press.) The quartile method is based on the difference score [(AAT+) - (AAT-)] and, therefore, the reliability of the scores obtained by this method

rests on the assumption that the subscales of AAT are statistically independent.

The purpose of this study was to investigate further the concurrent and predictive validity of the Achievement Anxiety Test. First, the relationships between the AAT Subscales and other measures of situation (state), specific (mathematics), and general (trait) anxiety were examined. The presence of two independent factors in the AAT was examined first by considering the relationship between AAT+ and AAT-, and second by means of a principal component factor analysis with an orthogonal rotation to final solution. The predictive validity was investigated by examining the relationship between AAT+ and AAT- with performance on a mathematics exam.

Instruments

State and Trait anxiety were measured using Spielberger's State and Trait Anxiety Inventory, STAI, (Spielberger, Gorsuch, and Lushene, 1970). Mathematics Anxiety was assessed by using a 24-item revised version of the 98-item Mathematics Anxiety Rating Scale (Gunn, Edie, Nicoletti, & Spinelli, 1972). The 24-item version has coefficient alpha reliability equal to .97 and correlates .98 with the full scale MARS (Plake & Parker, 1981). Mathematics Achievement was measured by a 43-item mathematics test which was derived from ACT's College Mathematics Placement Program to represent

a range of mathematics topics from elementary algebra through advanced high school level algebra (KR_{20} reliability = 91).

Method

The data was collected on 264 undergraduates from educational psychology classes at a large urban mid-western university. The subjects volunteered to participate in the study and earned class research credit which could count toward part of a class research requirement. All data were collected in one three hour evening session. The students were advised of the general nature of the study and informed that they had the right to withdraw from the study, without prejudice, at any time. All subjects elected to stay for the entire experimental session. Instruments were distributed in large envelopes to the subjects as they arrived at the experimental session. The envelopes contained all instruments: STAI-trait, STAI-state, MARS-revised and AAT preceded the mathematics test and were presented in balanced order.

Results

Means and standard deviations for STAI-trait, STAI-state, MARS-revised, AAT+ AAT- and the Mathematics Test are shown in Table 1. Table 2 contains a correlation matrix which shows the interrelationships of the instrument used in the study. AAT+'s Facilitating Scale showed a $-.24$ correlation with STAI-state and $-.28$ with STAI-trait,

and -.29 with revised MARS. The Debilitating Scale had positive correlations with STAI-state ($r = .38$), STAI-trait ($r = .56$), and revised MARS ($r = .54$). AAT+ and AAT- showed a relationship of $r = -.33$. These results seem consistent with those reported by Tryon (1980).

Insert Tables 1 & 2 about here

Revised MARS showed the best predictive power with relation to mathematics achievement ($r = -.44$) while there seems to be no functional difference in the predictive potency of AAT+, AAT-, STAI-state, or STAI-trait ($r = .22, -.23, -.21, \& -.13$, respectively); however, AAT+ did show a positive relationship with mathematics achievement whereas the other measures of anxiety showed negative relations, as expected.

A principal-component factor analysis using SMC's initially on the diagonal and iterations to a terminal solution was selected for the nineteen item AAT. Since each item is a 5-point Likert-type item, the elements in the input correlation matrix are correlations, not phi-coefficients as would have been the case with dichotomously scored items. Two solutions were considered. First, using the Kaiser criterion of an eigenvalue greater than one as the rule for number of factors to retain for rotation, five factors were extracted,

a solution which accounted for 56 percent of the total variance. A varimax orthogonal rotation was selected. After rotation, the fifth factor was discarded because it only had one loading higher than .40. The remaining four factors presented a complicated representation of the items; several items had multiple high loadings and one item did not have sufficiently high loadings ($<.40$) on any other of the factors.

The second factor analysis specifying a two factor solution was elected to provide an additional check on the soundness of considering AAT as being comprised of two independent factors as hypothesized by Alpert and Haber. Again, a principal component solution with iterations was elected. Two factors accounted for 38 percent of the total variance. A varimax rotation was selected in order to retain the orthogonality of the factors, and to increase the interpretability of the initial solution. Results of the two factor varimax rotation are shown in Table 3. Sixteen of the nineteen items had sufficiently high loadings on either of the two factors, using .40 as the cutoff value. Ten items had primary loadings on Factor 1 and all of which were from the ten-item Debilitating Scale of AAT. Six items had primary loadings on Factor 2, all of which are from the AAT+ subscale. The remaining three unidentified items were all from the Facilitating Scale.

Insert Table 3 here

The three items from the AAT Facilitating Scale which did not have primary loadings on either Factor I or Factor II were:

Although "cramming" under pre-examination tension is not effective for most people, I find that if the need arises, I can learn material immediately before an exam, even under considerable pressure, and successfully retain it to use on the exam.

When I start a test, nothing is able to distract me.

While I may (or may not) be nervous before taking an exam, once I start, I seem to forget to be nervous.

Conclusion

AAT subscales of Facilitating and Debilitating Anxiety performed consistently in their relationships to other measures of anxiety, mathematics achievement, and with themselves. AAT+ showed negative relationships with state, trait, and mathematics anxiety and a positive relationship with mathematics achievement. AAT-, on the other hand, had positive relationships with other measures of anxiety and a negative relationship with mathematics achievement. Correlation between AAT+ and AAT- was $-.33$. An initial factor analysis, using eigenvalues greater than one as the rule for number of factors to retain, resulted in a complex five factor solution which accounted for 56% of the total variance. The existence of five factors, using the eigenvalue greater than one criterion was also suggested for

the AAT by Revelle and Rocklin (1979). When a two factor solution was elected, the solution accounted for 38% of the total variance. Results of a varimax rotation showed that all the Debilitating Scale items loaded together on Factor I. Factor II contained high loadings for six of the nine items from the Facilitating Subscale. Three items were not strongly identified (cutoff value of .4) with either Factor I or Factor II.

These results suggest a potential revision of the AAT Scale to remove from the Facilitating Scale those items which do not have a primary loading to either factor, if the use of the subscales is one which requires independence of the two anxiety components, such as the use of difference scores. This suggestion must be tempered by the fact, however, that the two factor solution only accounted for 38% of the variance. A more prudent strategy might be to consider recasting anxiety into more factors than two, as would be suggested by the eigenvalue criterion solution which retained a total of five factors. Even that solution accounted for less than 60% of the total variance.

Educational Importance of the Study

Educational psychological and sociological researchers have been using AAT as a valuable research and clinical tool since its presentation in 1960. One of the reasons for popularity is due to the conceptual decomposition of the achievement anxiety into

two parts: facilitating and debilitating. Without benefit of empirical evidence to substantiate the claim, researchers have been treating the two scales as independent measures. Some researchers have used the difference of the two elements as an index for quantifying the combinational attributes of facilitating and debilitating anxiety. The quality of the reliability of the difference score rests on the independent nature of the components. This study gives cause to be concerned about the quality of a difference score due to the non-independence of the two scores. Further, the underlying structure of the instrument appears to be more complex than originally speculated by Alpert & Haber.

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Table 1

Means and Standard Deviations

AAT+, AAT-, STAI-state, STAI-trait, Revised MARS, mathematics test score

Variable	$\bar{X}$	sd
Math	25.35	9.67
Revised MARS	59.84	20.55
AAT+	25.31	4.77
AAT-	26.15	6.05
STAI-state	40.98	8.26
STAI-trait	36.96	7.49

Table 2
Correlation Matrix

	MATH	REVISED MARS	AAT+	AAT-	STAI- STATE	STAI- TRAIT
Math	1.0					
Revised MARS	-.44	1.0				
AAT+	.22	-.29	1.0			
AAT-	-.23	.54	-.33	1.0		
STAI- State	-.21	.52	-.24	.38	1.0	
STAI- Trait	-.13	.52	-.28	.56	.60	1.0

Table 3

Two Factor, Varimax Rotation Factor Loadings

Item No.	AAT Scale	Factor I	Factor II
1	D	.67	-.33
2	F	-.16	.55
3	D	.62	-.07
4	D	.61	-.03
5	D	.64	-.26
6	F	-.36	.38
7	D	.63	-.16
8	F	-.08	.44
9	F	-.04	.38
10	F	.22	.52
11	D	.63	-.02
12	F	-.11	.45
13	D	.54	-.11
14	D	.51	-.17
15	F	.01	.25
16	F	-.11	.54
17	D	.42	-.19
18	F	-.17	.55
19	D	.52	-.06